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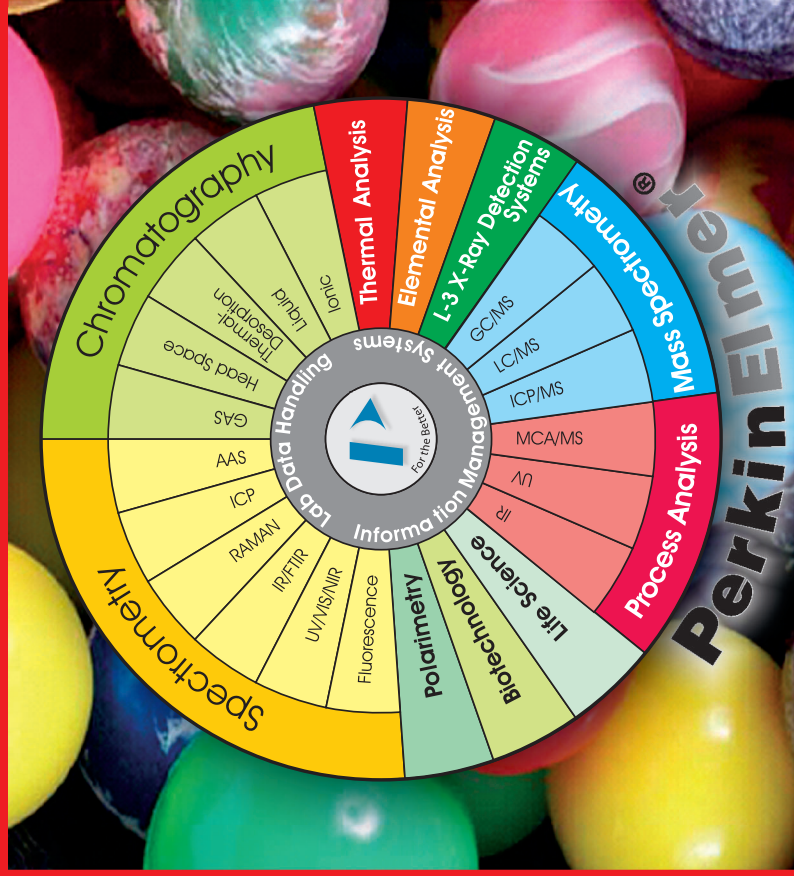
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Effect of organo-mineral fertilization on growth and development of perennial grass mixture, cultivated in Strandzha region

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Abstract. During the period 2005-2008 at the Experimental Station of Agriculture in the town of Sredets, based on field experiment with organo-mineral fertilization of grass mixture comprising: alfalfa (*Medicago sativa* L.)-60%, tall fescue (*Festuca arundinaceae*, Schreb.)-20%, and cocksfoot (*Dactylis glomerata* L.) - 20%. The following variants were included in the trial: 1. Background P80K80 -kg/ha - control, 2. N40P80K80 kg/ha; 3. N80P80K80 kg/ha; 4. N120P80K80 kg/ha; 5. Bovine manure of 20 t/ha; 6. Bovine manure of 40 t/ha; 7. Sheep manure of 20 t/ha; 8. Sheep manure of 40 t/ha; 9. Treatment was before sowing of seeds and three times as leaf fertilization with humustim. The purpose of this study was to test the influence of organo-mineral fertilization on the development of perennial grass mixture, cultivated in Strandzha region, Bulgaria. It was found that the fertilization with mineral fertilizer reduces the participation of pulses, increasing that of wheat and various types of grass. Fertilization with manure reinforces the presence of leguminous grasses, increases density, reduces participation of weeds and weed composition. Leaf treatment with humustim increases the participation of legumes and decreases weed components, but reduces the density of grass mixture.

Keywords: grass mixture, fertilization, botanical composition, Strandzha region

Introduction

The low mountain range of Strandzha-Sakar provides favorable conditions for cultivation of perennial grasses of suitable grass species ensuring high quality fodder for animals (Stoeva and Vateva, 2007). A series of studies of perennial grasses and grass mixtures have been carried out in our country in reference to factors influencing productivity (Pavlov, 1996; Totev et al., 2000). The creation of mixed wheat-leguminous grass provides fixation of a significant amount of atmospheric nitrogen, (Haveland and Richardson, 1992). Grass mixtures react most strongly to nitrogen fertilization, but the proper fertilization with nitrogen, phosphorus, potassium and others increases yields, improves fodder quality (Stoeva and Dimitrova-Doneva, 2002) and helps to provide ruminants with more and well-balanced fodder. The ways of usage affect significantly the participation of individual components in the grass, and the change in species composition affects its density (Churkova, 2000; Katova, 2007). On the other side, the botanical composition and density of grass are of practical importance for yield formation. The purpose of this study was to test the effect of organo-mineral fertilization on development of perennial grass mixture, cultivated in Strandzha.

Material and methods

The study was conducted in 2005-2008 in the experimental field of the Experimental Station of Agriculture in the town of Sredets, located in the region of Strandzha, on leached maroon forest soil,

with humus content of 2.5 % and low acid reaction. The experiment was realized in the spring of 2005 by the block method in four replications with size of vintage plot of 10 m² with suitable for the area grass mixture comprising: alfalfa (*Medicago sativa* L.)- 60%, tall fescue (*Festuca arundinaceae*, Schreb.) - 20% and cocksfoot (*Dactylis glomerata* L.) - 20%. The following variants were included in the test: 1. Background P80K80 kg/ha - control, 2. N40P80K80 kg/ha; 3. N80P80K80 kg/ha; 4. N120P80K80 kg/ha ; 5. Bovine manure - 20 t/ha; 6. Bovine manure - 40 t/ha; 7. Sheep manure - 20 t/ha; 8. Sheep manure - 40 t/ha; 9. Treatment was before sowing of seeds and three times as leaf fertilization with humustim.

The agricultural events, such as deep autumn plowing, disc-harrowing, cutting and rolling were carried out in stages at time according to the requirements. The sowing is done manually and dispersed at the end of March with sowing rate: for alfalfa - 25 kg/ha, for fescue - 25 kg/ha, and for cocksfoot - 20 kg/ha. The mowing is done in phase of haymaking maturity (ear formation – at the beginning of flowering). The study includes three rates of nitrogen fertilization - (N40, N80, N120 kg/ha) with background P80 K80, applied annually, once in spring. Phosphorus and potassium fertilizers were incorporated in stock with main treatment of soil. Organic fertilizers were applied annually in autumn. Leaf treatment with humustim was performed annually, three times during the vegetation of the grass mixture. In the first year of the period one mowing was done, and in the remaining three years - 2 mowings in phase beginning of flowering of the leguminous component.

In the course of four years the meteorological parameters rainfalls and air temperature, botanical composition of grass expressed in percentages, grass density measured as number per m² and height of plant cover in cm were measured. The accompanying indicators were measured before each mowing.

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Results and discussion

The geographical location of the Strandzha region determines the specificity of the manifestation of climate parameters. The presence of the Mediterranean influence makes winter warmer and without snow, and summer hotter and drier. Typical of the four-year period of study is the wide range of variation of rainfalls by months and years (Figure 1). The analysis of meteorological factors shows that the quantity and distribution of rainfalls during the study period is as follows: in 2005 the rainfalls are by 375,6 mm more, in 2006 by 73,8 mm less, in 2007 by 88,5 mm more, and in 2008 by 170,3 mm less

than average for a multiannual period (650,0 mm). The great quantity of rainfalls in 2005 (1025,6 mm), was a prerequisite for formation of well-developed and garnished crops. The drought in April, May and June of 2006 and February, March and April of 2007 (Figure 1) did not allow grass mixtures to fully exploit the nutrients of the imported fertilizers. They failed to show their maximum productive capacities. In general, during this period a trend towards drought with critical crisis periods in July and August was observed.

The average annual air temperature values are relatively more constant and range from 12.38 to 13.77°C in the years of observation. The average air temperature value during the study

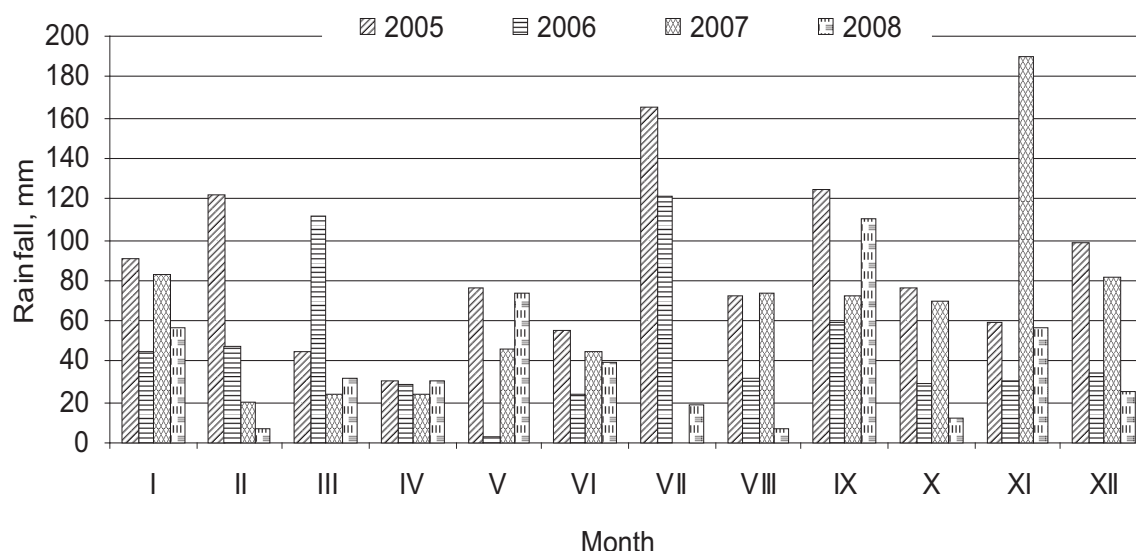


Figure 1. Rainfall (mm).

period is higher by 0.270°C than the rate for the region (12.760°C). The lowest average monthly temperatures are measured in January - 0.70 °C, and the hottest month is July with average monthly temperatures reaching 25.30°C (Figure 2). The climatic conditions in the area of habitat are one of the most important factors for growth and development of the productive capacity of any vegetation, including perennial grass mixtures.

After fertilization significant changes occur in yield determining factors height, density and botanical composition of grass. The height of grass in mowing maturity by variants and by years of study is shown in Figure 3. The plants are the lowest in the first year of mixture establishment. In the year of creation of grass, the average height of the mixture varies from 28,0 cm in variant 9, to 38,4 cm in variant 4. In the next years the height increases from 49,1 cm to 63,2

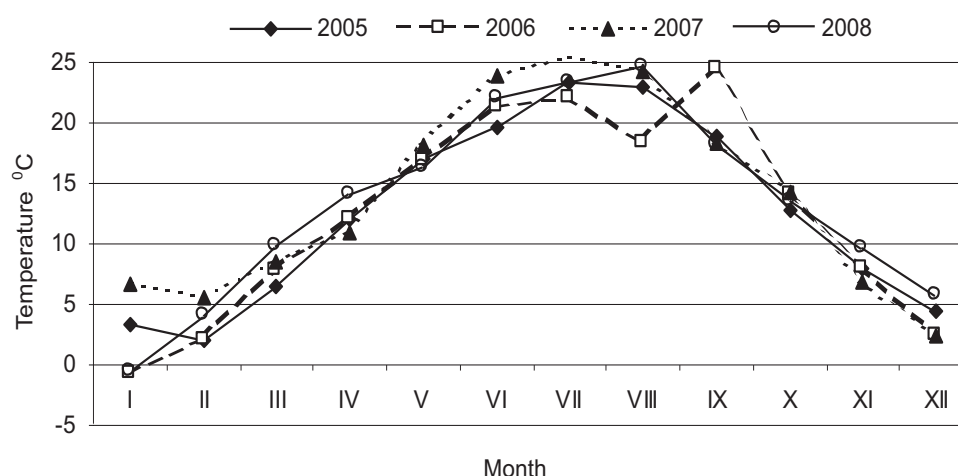


Figure 2. Average month temperatures (°C)

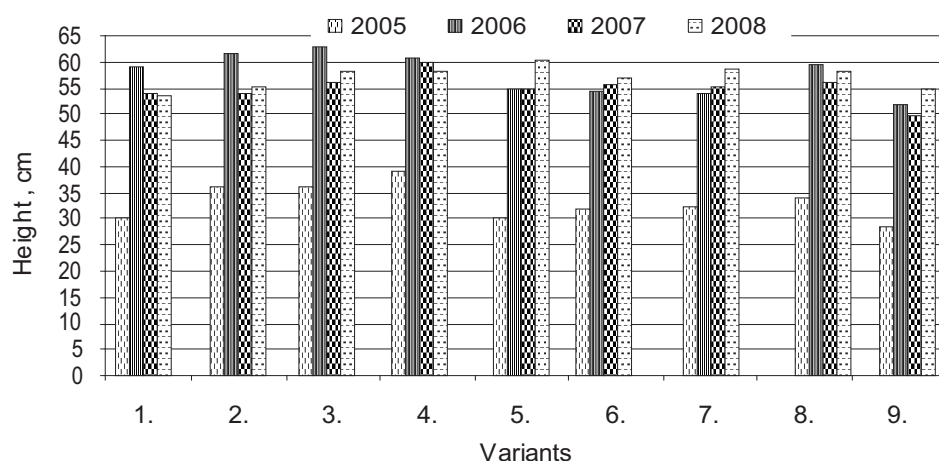


Figure 3. Height of the sward at mowing maturity (cm)

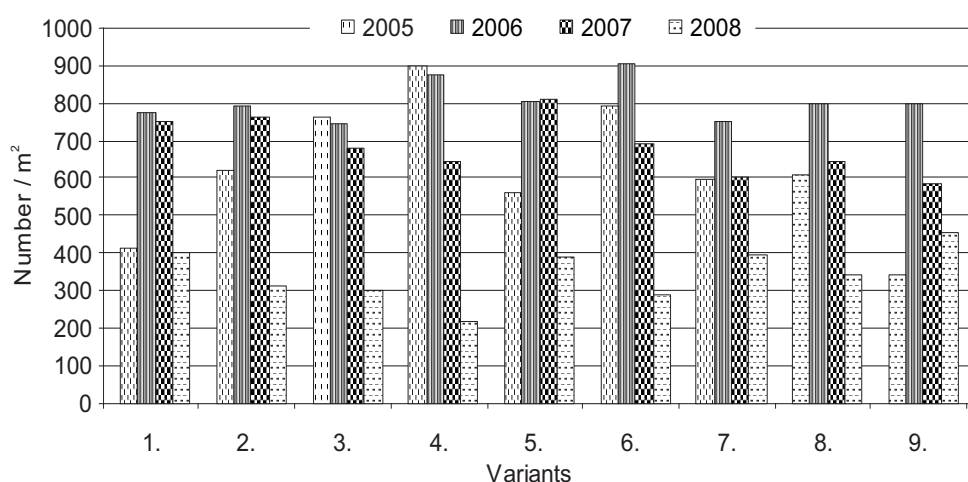


Figure 4. Density of a perennial herbaceous mixture in years, n/m²

cm. The lowest are the plants in variant 9, followed by the control. The other variants are the highest in 2006 - from 53.4 to 63.2 cm, due to increased growth of grass mixtures because of unusually warm winter and adequate rainfalls early in spring. During the third year of experiment, the average height of grass mixture was from 53.5 to 59.5 cm. In the last year the fertilized grass mixture had plant height from 54.7 to 59.7 cm. Average for the period, the lowest were the plants treated with humustim - 45.6 cm, followed by the control, fertilized with P8K8. The highest were the plants fertilized with nitrogen - from 51.2 to 53.9 cm. In variants fertilized with manure, the average height of grass species was smaller - from 49.1 cm to 51.4 cm (Figure 3).

The density of grass, by years of study, expressed in pcs/m² is shown in Figure 4. The number of pulses and cereals per m² is the lowest in 2005 - from 420 to 906. The highest is the density of grass mixtures in 2006 and 2007 from 754-907 and 608-813 pieces, respectively. In the fourth year of the period (2008), this indicator decreased strongly - from 223 pcs/m² (for variant 4) to 456 pcs/m² (for variant 9). On average for the period of observation, the highest number of plants was in variant 6 (bovine manure - 40 t/ha) - 672, exceeding the standard by 14.1%. The remaining indicators were

from 0.3% in variant 7, to 12.9% for variant 4. Only variant 10 (treated by humustim) had indicators below the standard (93.0%).

The botanical composition of grass, shown in Figure 5 reflects the changes in variants during the years of study. The botanical composition, which reflects the weight ratio of components in grass mixture, was with the lowest participation of leguminous and cereal components in the first year of creation of the mixture. In the second year, the participation of leguminous grasses was from 38 to 68%, of wheat - from 30 to 60%, and the least were the weeds - between 1 and 3%. In the remaining two years of the period the high presence of leguminous grasses in the mixture was preserved and even strengthened, wheat grasses gradually decreased their participation, especially in the variants fertilized by manure and humustim. In the last year of experiment the participation of weeds and legume components was increased. On average for the study period the weight participation of legumes in the mixture is the highest in the variants fertilized by manure and humustim - from 50 to 58%, at fertilization with nitrogen fertilizer - from 33 to 42%. The participation of wheat in grass mixtures was inversely proportional to leguminous, and that of weeds was from 23 to 34%.

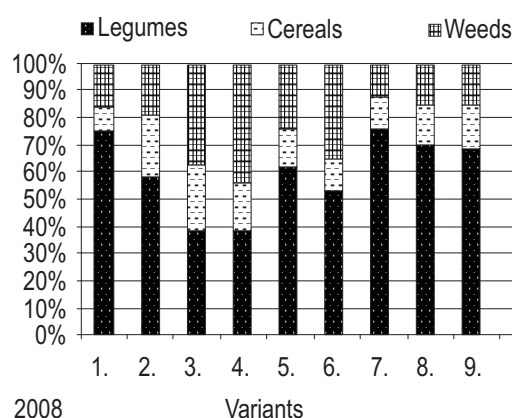
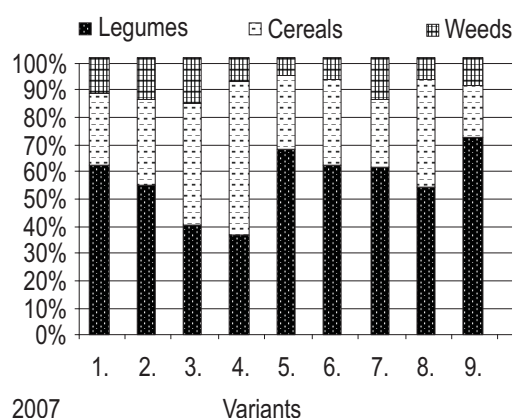
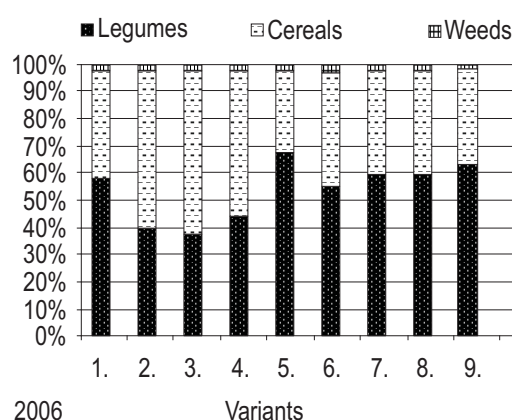
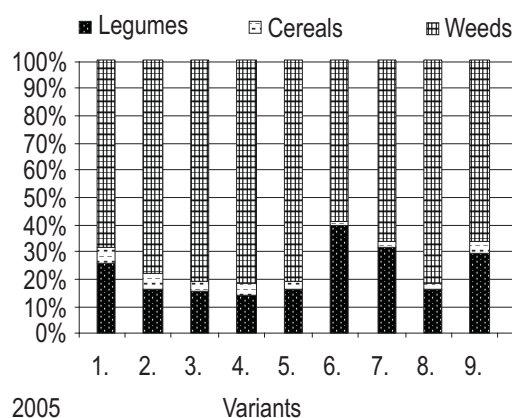


Figure 5. Botanical composition, %

Conclusion

Organo-mineral fertilization of grass mixtures influences the botanical composition, height and density of the grass. Regarding the quality of grass mixtures, fertilization with mineral fertilizer reduces the participation of legumes, thus increasing that of weeds and different grasses. Fertilization with manure reinforces the presence of leguminous grasses, increases density and reduces participation of weeds and crop components. Leaf treatment with Humustim, increases participation of leguminous at expense of weed components, but reduces the density of grass mixtures.

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